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N. E. HOFFMAN
ELECTRICAL CONNECTOR

2,685,076

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Fig. 1.

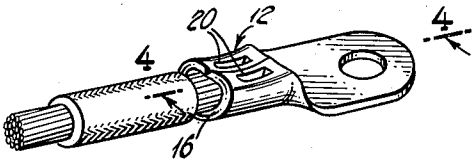


Fig. 2.

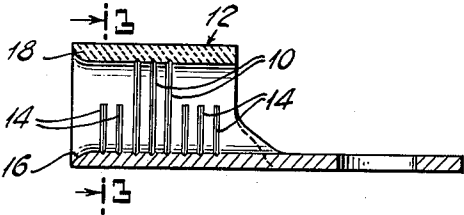


Fig. 3.

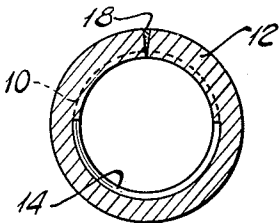


Fig. 4.

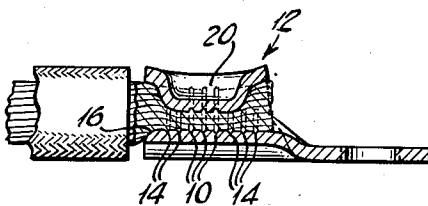
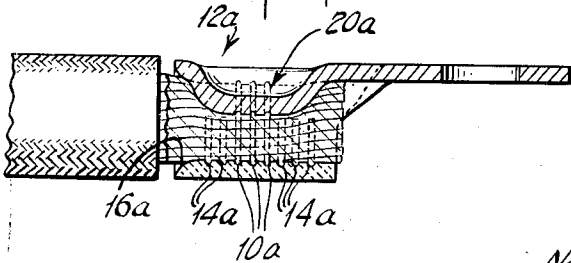


Fig. 5.



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UNITED STATES PATENT OFFICE

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ELECTRICAL CONNECTOR

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2 Claims. (Cl. 339—276)

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This invention relates to electrical connectors and the like and to electrical connections made therefrom. More particularly, it relates to connectors comprising a ferrule-forming portion adapted to be engaged with a wire or the like by pressure-forging of the ferrule portion onto the wire by means of an indenting die.

The use of abrupt-angle-edged wire gripping grooves on the interior surface of a ferrule-forming portion has been found, as set forth in the patent of Stephen M. Buchanan No. 2,379,567 to give both a stronger tensile connection and a better electrical connection when such a connector is pressure-formed onto a wire. When such a connection is slit open it is found that the metal of the wire has been extruded or coined down into these wire gripping grooves; thus forming a mechanical key and multiple electrical contact lines where presumably the outside coating of the surface of the metals has been broken. The Carlson application Serial No. 455,034 filed August 11, 1942, now Patent No. 2,385,792, disclosed the forming of connector ferrules from sheet metal by bringing the edges together and brazing the seam where the edges meet; and this is more particularly described and claimed in its application to transversely grooved ferrules in his copending application Serial No. 530,336, filed April 10, 1944.

The patent of Freedom No. 2,535,013 shows the use of such a ferrule by pressure-forging onto a wire under longitudinally positioned indentors. Other types of indentation crimps are shown in the patents of Davis No. 2,109,837 and of Thomas, No. 2,275,163.

A great deal of research and experiment has gone into the design of the indenting tools so as to produce the optimum in holding strength and in maintained electrical conductivity through the connection. In the course of such experiments it has been shown that indentors which would be otherwise desirable occasionally shear or tear the metal at the longitudinal ends of the indent; so that it has been necessary to very carefully form indentors so as to produce smooth drawing in this area without rupture of the metal. I have now demonstrated that this has been to a substantial degree caused by the presence of the sharp grooves in this draft area at the ends of the indent.

Notwithstanding the apparent relation between the grooving of the ferrule and its tendency to rupture under the crimping die, it is not satisfactory to omit the grooving as its omission results in a substantially inferior connection. I have now discovered, however, that it is possible to attain

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the necessary function of the transverse grooving by including it in the area at the bottom of indentation and on the opposite side of the ferrule where the indenting pressure forces the wire against the bottom of the ferrule bore, and at the same time to avoid the tendency to rupture the metal at the end of the indent by terminating the grooves substantially beyond the draft areas at the ends of the indent.

In the accompanying drawings I have set forth one embodiment of my invention as applied to the ferrule indent crimp of the Freedom Patent No. 2,535,013 and as applied to the single indent crimp of the Davis Patent No. 2,109,837. It will be understood, however, that these showings and the accompanying description are not intended to be exhaustive or limiting of the invention, but on the contrary are given with a view to enabling others not only to practice my invention but to fully understand it and the principles thereof so that they will be enabled readily to modify these examples and adapt the invention and embody it in many forms, each as may be best suited to the conditions of a particular use.

In the accompanying drawings:

Figure 1 is a perspective view of a connection made in accordance with the Freedom Patent No. 2,535,013;

Figure 2 is a view in longitudinal section of a connector embodying my invention adapted for use in making a connection such as that shown in Fig. 1 or Figs. 4 and 5;

Figure 3 is a cross-section taken on line 3—3 of Fig. 2;

Figure 4 is a longitudinal section taken on the line 4—4 of Fig. 1, and,

Figure 5 is a longitudinal, axial section showing a single indent type crimped connection with a connector embodying my invention.

Referring first to Figs. 2 and 3, I have there shown a type of connector made by stamping out a flat blank from soft electrical copper with wire gripping grooves 10 extending from edge to edge in the central area of a ferrule portion 12, and with shorter grooves 14 extending across about the middle half of the width, thereby leaving beyond the ends of these on each side of the longer grooves, about one-quarter of the width adjacent each edge in which no grooves are formed. The end edge is formed with a smooth rounded curvature or bell mouth 16 as shown. The lateral edges of the ferrule portion 12 meet at the line 18 and are there brazed to form a water-tight seam substantially flush with the inner and outer surface of the ferrule material.

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For ordinary use I prefer to use a self-fluxing brazing material such as the silver phosphorus alloy sold commercially by Handy and Harman under the trade name Silfos; but other available brazing materials are well known in the art.

The grooves advantageously meet the inner cylindrical surface of the ferrule portion in an abrupt-angular edge and they may be V-bottom as shown in Fig. 4 or with advantage may have rounded bottoms and be somewhat wider, as shown in Fig. 5. As shown in Fig. 3, for example, these grooves may be from .005-.01 inch deep and from .025 to .050 inch wide when the copper used for the terminal is from .025 to .050" in thickness.

The terminal after manufacture or during the brazing operation may be fully annealed or the stock from which it is made may be soft, fully annealed pure copper and the work hardening produced by bending and by stamping the grooves and the bell mouth may be left.

The tongue, shown in this instance as a ring tongue, is not essential to the present invention. As is well understood by those skilled in the art, this may be replaced by other forms of tongue such as spade tongue, pin type, socket type, etc. or may be omitted where two wires are to be connected together by inserting in opposite ends of the ferrule portion and crimping the ferrule onto them.

In Figs. 1 and 4, I have shown the connector of Figs. 2 and 3 after crimping onto a wire by means of the parallel indent type of crimp described in the Freedom Patent No. 2,535,013. As will be apparent from the sectional view of Fig. 4, the draft areas adjacent the longitudinal ends of the indent 20 where the metal is drawn down from the larger diameter to the bottom of the indent, are free from grooves; whereas the area at the bottom of the ferrule portion opposite these draft areas is provided with grooves so that the pressure of the indentation against the wire will form the wire down into these grooves and give a maximum holding power and conductivity in the connection.

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In Fig. 5, I have shown a similar connector, but, in this case, with the shorter grooves 14a extending for about one-quarter of the width from each of the lateral edges in the longitudinal brazed seam of the ferrule. As shown in Fig. 5, this connector has been attached to a wire by a single pressure indentation 20a from the side opposite to the brazed seam. Thus the draft areas at the longitudinal ends of the indent occur in the smooth metal where it is free from the transverse grooves; whereas the opposite side of the ferrule is provided with such grooves and the metal of the wire is therefore coined down into those grooves by the pressure exerted in forming the indentation.

I claim:

1. An electrical connector for connection to a conductor by pressure indenting of the type wherein at least one portion of the connector is subjected to a material drawing thereof which comprises a ferrule-forming portion having its inner face formed with at least one wire gripping groove extending transversely across the ferrule portion centrally of an area adapted to form the bottom of the indentation when the connector is indented on a conductor, the adjacent areas beyond said area of indentation, which in the indented connection slope from the indentation longitudinally of the ferrule, being substantially free from such wire gripping grooves.

2. An electrical connector as defined in claim 1 in which the interior surface of the ferrule portion is provided with a plurality of spaced abrupt-angular-edged grooves in the area thereof which is adapted to lie opposite said adjacent ungrooved areas.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,068,152	Rowe	Jan. 19, 1937
2,379,567	Buchanan	July 3, 1945